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A Weekly Journal Devoted to Industrial and Engineering Chemistry

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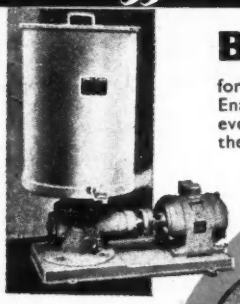

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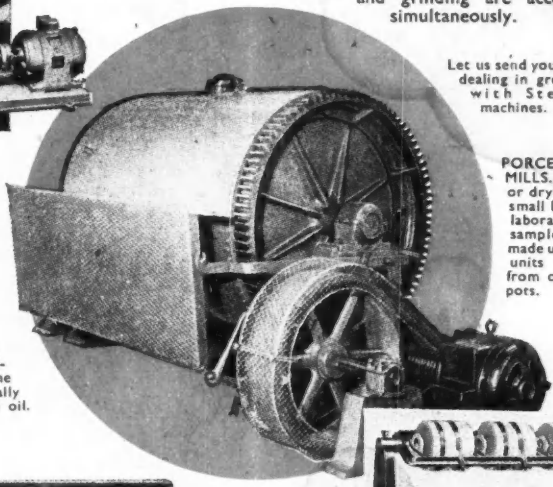

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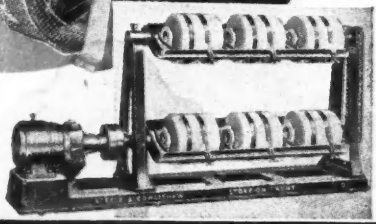

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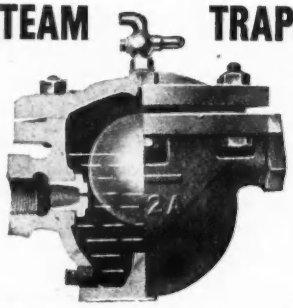

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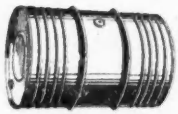

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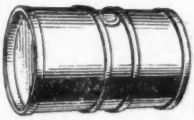

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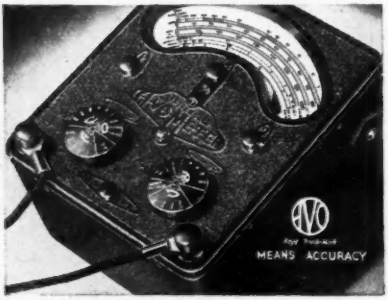

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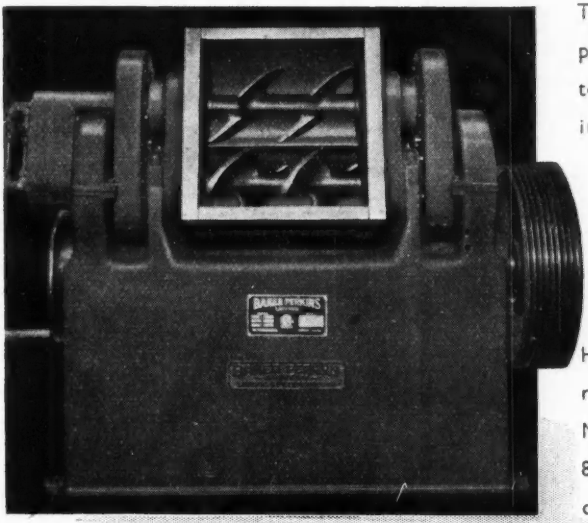

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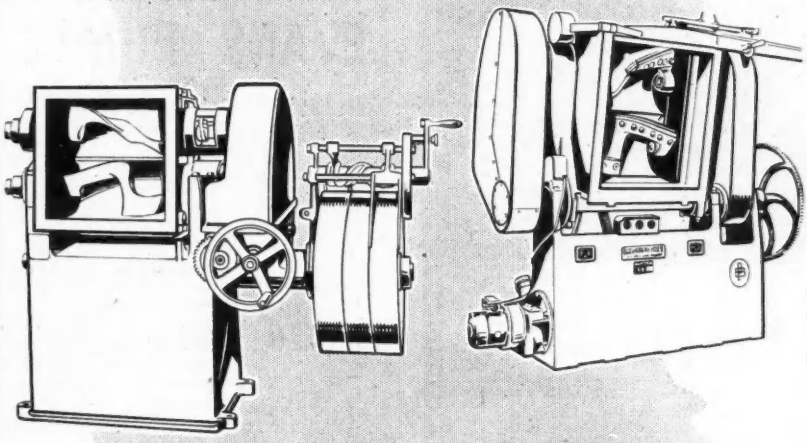

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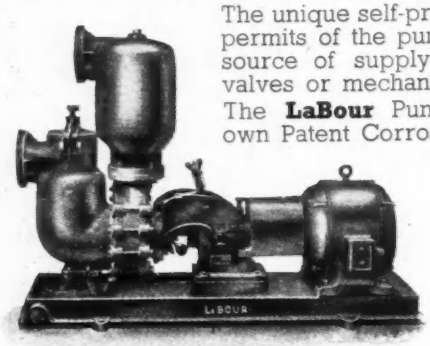

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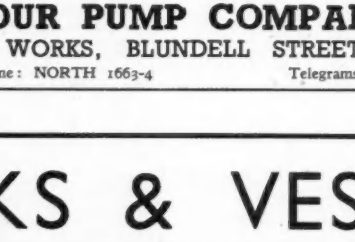

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Precept upon Precept

TO what extent does the chemical industry learn by experience? To what extent does it learn by precept and example? How far is it receptive? Great corporations are seldom receptive; they are too large to have a brain that can think in a corporate sense, and much is of necessity left to the many minor officials, who will obviously have the highest opinion of their own value and ability. In saying that we do not necessarily quote our own view; it is a very common experience that unless exactly the right approach is found large concerns are rather like St. Paul's; one cannot placate the Dean and Chapter by stroking the dome. There is very general agreement that all is not well in the chemical industry and that a good deal must be done to prepare for conditions in the post-war world.

It is for this reason that we here present a little true tale of what is being done in other industries in the hope that the chemical industry will sit up and take notice. There was a time when men spoke of the Atlantic Charter and all the searchings for post-war Utopia as though they were not means to a possible end, but the roseate hues of early dawn itself. After confusing the shadow for the substance we have settled down to the realisation that man will still live either by the sweat of his brow or by his brain. Perhaps Sir William Beveridge should be thanked for that achievement. Had he not startled people into asking whence the money was to come, we might not even now have awakened. Be that as it may, we *have* awakened and have come to realise that this nation can keep up its standard of living after the war only by the age-old process of earning its livelihood. In plain English we can only maintain ourselves by our exports. The fundamental problem of the post-war years is now seen to be to find means whereby we can export sufficiently to keep ourselves.

This problem requires the solution of several component problems. There is the problem of getting paid for the exports in view of the dilapidated state of the world and of the finances of those nations which will most desire to buy from us. There is the problem of persuading those who can pay to buy from us rather than from others. There is the problem of being able to supply our potential customers with what they want. Fortunately it is not necessary for each one to find an answer to all three of these problems. The problem of payment

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is one for the economist, the banker, and the politician. It is a major problem of Government. The problem of persuading the customer to buy from us has two aspects: sales and technological. On the sales side there is the necessity for skilled technical salesmen who can live abroad and who can present the case for British goods. There is also the Government problem, for much can be done by astute political assistance. In introducing the debate on the reform of the Foreign Office, Mr. Law said that the Foreign Service of the future would have to give all the ability it could to our exports and do everything it could to reviving, developing, and increasing our export trade. The Government is thus well aware of its part in this problem, and looks to industry to take its share also.

While representation abroad, in addition to our Consular Service, should be an important part of any export drive, the whole position must be based on technical ability. Unless we are properly organised at home we cannot hope to compete with the highly organised chemical and chemical-plant industries abroad. Unless we are able to equal or surpass in technical excellence our opposite numbers abroad, we cannot hope to secure foreign orders. There is still, to-day, much secrecy in the chemical industry and there are still many who maintain that they cannot "give away" their supposed secrets without dire calamity to their own interests. Harriet Martineau in *Eastern Life* has said: "Moses in Midian perceived a mighty truth, a truth so holy and vast that even yet mankind seem scarcely able to apprehend it—the truth that all ideas are the common heritage of all men, and that none is too precious to be communicated to every human mind." There is one great industry at least that seems to have grasped what that means.

This particular industry realised that its future was dark and that it was threatened at home and abroad by foreign interests. It was saved by protective tariffs and then proceeded to build up its plant to modern standards. Then war came that shook all industry to its foundations and laid bare deficiencies. It was recognised that even though great technical improvements had been made, still more remained to be done. It was recognised that developments abroad would not keep pace with those at home, but that the race was to the swift. It was recognised moreover that the manufacturing side and the plant-constructing side must work together with common councils and common objectives. The important step was taken of placing on the Board of two of the largest plant-constructing companies the chairmen of three of the largest manufacturing companies. This was not a financial transaction; it was carried out for purely technical reasons in order that both sides should put their house in order. Why should it not be done in the chemical industry also?

There will no doubt be those who will ask for chapter and verse. What industry is this and what has been done? Here are the facts as published. In September, 1942, the chairmen of three great steel companies became directors of the Davy and United Engineering Co., Ltd. These directors were Mr. A. C. MacDiarmid (Stewarts and Lloyds), Sir Walter Benton Jones (United Steel Companies) and Mr. John E. James (Lancashire Steel Corporation). It was at that time announced that the arrangement was made with the object of establishing closer technical collaboration between the maker and user of steelworks equipment, and of ensuring a progressive policy of technical development in the joint interests of the engineering and the steel industry. In March, 1943, it has been announced that the same three gentlemen with Mr. G. S. McLay (Stewarts and Lloyds) have joined the Board of the Wellman Smith Owen Engineering Corporation, Ltd., with the same objects. "This move," we are told, "would seem to indicate a further extension of the policy of bringing the makers of iron and steel works plants into closer union with the principal users of those plants so as to promote technical development and to meet foreign competition." It is believed, in that industry, that by co-operation between manufacturer and user, and by a modicum of rationalisation, strong and efficient groups can be built up which are of national value in times of difficulty and of no less value for the home and export trade in normal times. Precept upon precept, line upon line, here a little and there a little; can we not learn something ourselves from these events?

NOTES AND COMMENTS

A Future Fuel Policy

AMONG many other interesting items in his talk to the Fuel Luncheon Club recently, Colonel Bristow put forward some concrete suggestions of how a constructive post-war fuel policy, suited to the needs of this country, might be built up. Like all the best plans devised for the better running of affairs of great national importance, Colonel Bristow's scheme is of semi-official, semi-unofficial nature. This augurs well for its success, as this kind of collaboration between the interests of the State and those of the individual appears peculiarly suited to our national temperament. While ultimately the Government must be responsible for the decisions of fuel, as of other, policy, the advisory councils proposed by Colonel Bristow for the coal, fuel-oil, and petroleum industries would obviously expect their directions to be taken seriously. Members of these councils will be nominated by the bodies already in existence representing the various industries concerned, not forgetting the industrial chemical associations, who should play an increasingly important part in the proceedings. The comparative neglect of the utilisation of the by-products of coal in the chemical industries is a reproach that we cannot allow to persist if we are to take a fitting place in the scale of post-war trade. The arrangements suggested by Colonel Bristow for the allocation of research likewise bear careful study. A priority system managed by the general council responsible for the whole industry concerned should certainly avoid any duplication or misdirection of effort, such as many research workers have felt to be dogging their steps in the not too distant past.

Steel Standards Summarised

IN view of the large and increasing number of specifications for iron and steel, the new publication of the British Standards Institution (No. B.S. 1111) entitled a Summary of British and American Standard Specifications for Iron and Steel, is particularly welcome, especially as it takes into account the British Standard Aircraft Series and the series of D.T.D. Specifications of the Ministry of Aircraft Production. Up to the present, a user of steel wishing to find out whether a specification existed for any kind of steel would have to consult a great many publications before he could be satisfied as to the correct answer; the new tabulated summary, however, sets out the details of the various specifications in a single publication. It should be remembered, of course, that this summary is intended for reference purposes only; although it includes details of the chemical composition of steels, and also their mechanical properties it does not cover such points as the number and nature of tests to be taken, so that it is still essential to consult the appropriate specification. The great point is that the index number of the appropriate specification can now be found at a glance. The amplitude of recent steel deliveries from the United States encouraged the Institution to include useful details of American steels, and the general utility of the summary is greatly enhanced thereby.

Underground Gasification

INTEREST in the method by which the Russians carry out their gasification of coal underground is increasing in this country. Within the past fortnight two questions on the subject have been asked in Parliament, and the Minister of Fuel and Power has disclosed that we have asked for a report on underground gasification from the Russian authorities. Equally noteworthy was his statement that the process is being investigated in this country and that an experimental plant has been estabished in Scotland. As long ago as March, 1941, CHEMICAL AGE published an article on underground gasification by M. Beniaminov. At that time the first underground gasification station on a commercial scale had started operations in the Moscow coalfields, and another large station was under way in the Donetz basin. Others have since been built and there can be little doubt that but for the war this interesting new development in coal technology would have been further exploited. One objection to underground gasification which has been raised in this country is that it would not be feasible in British coalfields as the coal seams are too deep. There is, however, little evidence to support this idea, and it

would seem more likely that the length of the coal seams rather than their depth below ground would be the physical controlling factor. On the chemical side it is clear that the economics of the process are largely determined by the cost of the oxygen needed to promote the gasification of the coal. In Russia it was found that the ordinary production of this commodity in high-pressure plants was too expensive, but the difficulty was solved when Prof. Kapitsa devised a turbine for the production of liquid air which operates at pressures as low as five or six atmospheres.

A British Idea

THE success of the Russian process is a challenge to British technology particularly in view of the fact that it was a British chemist, Sir William Ramsay, who first drew up a practical scheme whereby coal could be converted into gas in the mine. In those days they went so far as to sink a shaft in the Durham coalfields. But the experiment was abandoned, because of the apathy of the Government and the industry. It was Lenin who, attracted by the idea when he read some comments on Ramsay's project in technical journals, coupled the problem of underground gasification with the enormous task of electrifying Russia. He commented: "The world-renowned English chemist has invented a means of getting gas direct from the seam of coal *in situ*. One of the problems of modern technique is thus approaching solution. If this technical revolution took place the cost of electrical energy would be reduced to one-fifth of its present cost. An enormous amount of human labour that is now spent in extracting and distributing coal will be saved." Between the time when Lenin first gave underground gasification his blessing and the building of the first commercial plant there has been a technical change of direction, the process being used rather as a source of chemical products than to provide power. The original scheme whereby it would provide electrical power has not been neglected, and at one of these gas stations a gas turbine designed by Prof. Makovsky has been installed which the Russians believe will be more efficient than the steam boilers ordinarily used. It has been remarked by J. G. Crowther that the tendency exists in fuel technology for scientists to become bored with the old fuels like coal and pursue the entertaining novelties of the new fuels, a trend which is usually uneconomic and disadvantageous to the State. Research into underground gasification would doubtless yield a great many new angles which would contribute to the development of both the coal and the chemical industries. It is a process which offers great possibilities and it is to be hoped that the experiments now in progress will not be abandoned as lightly as was Ramsay's project.

Peru's Metal Production

THE war has led to the development of Peru's metallurgical industry. Last year, for instance, considerable activity in the expansion of the tungsten industry was reported, the output of the year being estimated at 325 tons of tungsten concentrates with an average content of 65 per cent. metal. In August, 1942, the Cia. Minera Tauca, the ore reserves of which are assessed at 15,650 short tons with an average WO_3 content of 1.23 per cent., began production, and at Pasto Bueno a tungsten concentrator with a daily capacity of 30-40 tons was installed to handle ores from small mines in that region. Production of vanadium in the first half of 1942 was reported to be 2741 metric tons of concentrates averaging 15.7 per cent. vanadium and 5836 tons of ores averaging 4 per cent. Copper production, though yielding less blister copper, made available for export 36,965 metric tons. For 1942 the output of lead was originally estimated at 50,000 metric tons, but this figure has been exceeded by about 10 per cent. Zinc production was nearly 30,000 metric tons, and bismuth 350 tons. Mercury ores are processed in small quantities, but production could be stepped up by full utilisation of the resources of the Santa Barbara mine, which has reserves reported at 1,000,000 short tons of 0.12 per cent. ore.

To encourage the further development of tungsten in the United States, the Bureau of Mines has published a circular describing how a relatively small mill in Idaho successfully handled complex hubnerite ores to produce tungsten concentrates. By combining gravity concentration, flotation and magnetic separation, the mill handled 0.5 per cent. tungsten ore and produced concentrates averaging about 67 per cent.

Hardened Edible Oils

The Selection of Suitable Plant and Processes

by H. R. MITCHELL, M.I.Chem.E.

(Oil and Hydrogenation Technologist to Power-Gas Corporation, Ltd.)

IN many countries extending all over the world, and particularly in the United Kingdom and the U.S.A., hardened oils now form an integral part of the oils and fats industry. It is hoped, therefore, that this article will not be considered as an attempt to offer something original or revolutionary to the existing scientific literature and technology of the subject. Obviously, during the period of the present war, extensions and developments must be severely restricted. Afterwards, however, industrialists of many nations will be replacing out-of-date plant and re-establishing that which has been damaged and neglected. Others will desire to instal new refineries to provide fatty foods for their compatriots, particularly in those countries that have been directly affected by the ravages of war. With this in mind, a brief survey of the history of oil-hardening and a short introduction to the technique of the operations involved is given for the benefit of those who have not a highly specialised chemical and engineering knowledge of edible-oil refining and hydrogenation. An endeavour has been made to present the subject in a manner which, without delving too deeply into the intricacies of scientific and technological problems, will nevertheless provide the required information regarding the nature and purpose of each operation comprising the complete process; and moreover, by a review of the variations and modifications which have been applied during the past twenty years, to indicate how the process can be operated in accordance with present-day technique with well-designed plant of modern construction.

Prior to the war of 1914-1918, hydrogenation as applied to oil-hardening was in its infancy. That war brought the process into prominence and it developed rapidly. By 1920, oil-hardening had become an industry of primary importance. It was in no way perfect, however; there were many technical difficulties. Plant was expensive, catalysts and catalyst preparation more so, and although the development of the electrolytic cell had indicated that hydrogen gas could be produced from water, with less difficulty and with a purity higher than gas produced by the steam-iron process at that time, the prevailing cost of electricity did nothing to reduce the high cost of hydrogen. Thus it was that the hydrogenation of oils and fats by existing methods could not be made a paying proposition by the small oil refiner and so the hardened oil industry for many years was to a great extent exclusive to the big companies. One by one the various technical difficulties were overcome; new methods of catalyst production and recovery reduced the catalyst cost; hydrogen production was made available in smaller quantities at competitive prices, and plant in general began to be constructed on smaller and improved lines with the corresponding decrease in capital outlay. For some ten years or more now it has been established that oil-hardening is not exclusive to the manufacturer of 50, 100 and 200 tons per day, but is equally an economic proposition for the refiner of only 5, 10 and 20 tons per day.

Refining and Hydrogenation

Before turning to the description of the various operations and processes by which edible hardened fats are produced it would be as well to consider the fundamental principles of hydrogenation and its place in the general practice of refining vegetable and marine oils for edible purposes. When liquid oils are in their crude condition, with almost the sole exception of olive oil used as salad oil, they are unsuited to edible purposes; not only on account of their liquid state, but also by reason of the impurities they contain and the flavours of their source. In order to effect purification, they are subjected to a refining process which removes the acidity, the proteins, colouring matters, and other undesirable substances, but this process does not cause the oils to solidify; the solidification or

hardening is brought about by hydrogenation.

Liquid oils consist mainly of oleine whereas solid fats consist mainly of stearine. The only difference between oleine and stearine is that the latter contains up to ¾ per cent. by weight more hydrogen than the former. When oil, therefore, is brought into intimate contact with hydrogen in the presence of a "catalyst," the hydrogen combines with the oil, oleine becomes stearine, and the oil solidifies, hardness of the product being controlled by the amount of hydrogen that is allowed to combine with oil. The catalyst does not enter into combination with the oil and is merely an introducer of the hydrogen to the oil, without which introduction no temperature or pressure would cause the combination to take place. Since Norman's patent in 1903 many others have been granted for various modifications of this hydrogenation process, so that, up to the present, something well over 500 patents must have been recorded. A wide range has been covered by these patents, including the use or preparation of many substances used as catalysts and supports; various methods and types of equipment for bringing the oil, catalyst, and hydrogen into intimate contact; and also means of recovering and the utilisation of spent or poisoned catalyst. The oil, solidified by hydrogenation, passes to a final purifying stage where any remaining flavours and odours are removed by a process of deodorisation.

Although there have been many modifications and improvements during the past thirty years, the complete process still consists of the following operations: (1) refining; (2) hydrogen production; (3) hydrogenation; (4) after-treatment of the hydrogenated oil; (5) recovery and reactivation of the catalyst.

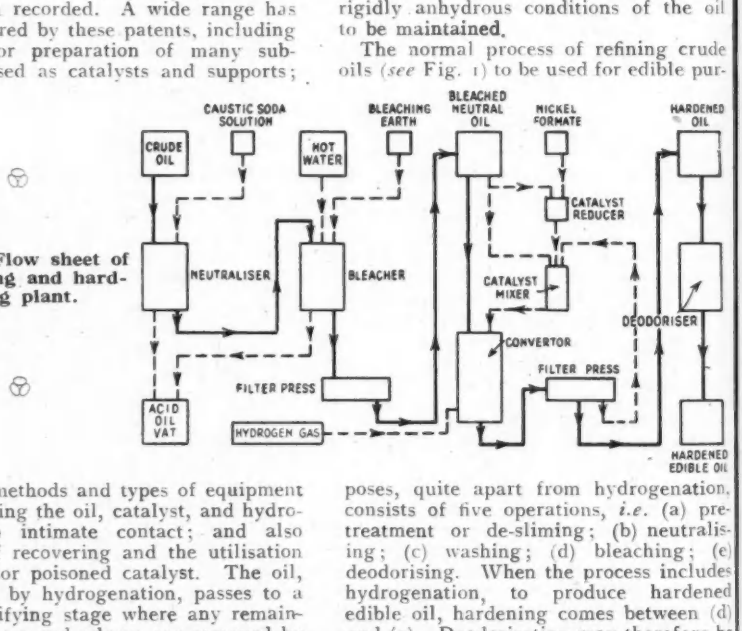

Fig. 1.—Flow sheet of oil-refining and hardening plant.

Purification or Refining

The importance of refining oils irrespective of the method employed cannot be over-emphasised. There is always a larger or smaller amount of free fatty acids, albuminous matter, organic sulphur compounds, and traces of phosphorus containing lecithin, etc., present in the crude oil. All these interfere with the hardening process. They exercise a toxic effect on the catalyst reducing its catalytic usefulness and rendering it prematurely inactive. It will be obvious, therefore, that owing to their absorption by the nickel catalyst in preference to that of the fatty compounds, all these impurities must be eliminated as completely as possible. Moisture must also be avoided, though it is not essential for rigidly anhydrous conditions of the oil to be maintained.

The normal process of refining crude oils (*see* Fig. 1) to be used for edible purposes, quite apart from hydrogenation, consists of five operations, *i.e.* (a) pretreatment or de-sliming; (b) neutralising; (c) washing; (d) bleaching; (e) deodorising. When the process includes hydrogenation, to produce hardened edible oil, hardening comes between (d) and (e). Deodorisation may therefore be more aptly described as "after-treatment of hardened oil," and in this article it is dealt with under that heading.

As methods and machinery improve

for milling, pressing, or otherwise treating nuts and seeds to extract their oil, crude oils of a quality requiring any serious pre-treatment are not so often met. Nevertheless there are still many cases of careless pressing whereby oils enter refineries while still containing sufficient protein and mucilaginous material to cause serious trouble and loss in refining unless this material is first removed. Some degree of pre-treatment is always necessary with nearly every kind of oil to prepare it for neutralisation. This may take the form of simple settlement or filtration with one of the diatomaceous earths. With some liquid oils, however, a careful treatment with steam, water, and even mineral acids or other chemicals is required. The problem, however, is not a serious one nowadays and there are many satisfactory methods well known to competent oil technologists for dealing with it.

Neutralising

During the past twenty years a large number of processes for neutralising oils and fats for edible purposes have received attention and interest. While admitting that local conditions can influence the choice of process and plant, it is nevertheless a fact that in many cases methods are still being used which are by no means entirely satisfactory. Despite, however, these admitted difficulties of local or domestic conditions, there is really nothing to prevent a manufacturer from carrying out this stage of his production of edible fats in an efficient, practical, and economical manner. At present the most popular method of removing the free fatty acids of crude edible oils is that of neutralisation by alkali, generally with caustic soda solutions in various concentrations and at temperatures which experience has shown as being most suitable for the particular variety and quality of oil to be dealt with.

The construction and shape of the neutralising vessel has a definite bearing on the efficiency of neutralisation, and practical experience has shown that the type of agitation is a matter of supreme importance. The ideal agitator is one which will give all the agitation necessary, effectively throughout the whole bulk of the oil, but in no way introduce such violence as to cause local emulsification. Some types of agitating gear depend on the effect of one or more small propellers, running at high speed, to maintain adequate mixing; but this procedure in a neutraliser is fatal. The soap will not " grain " well because particles which should be flocculent will be broken up into very small light particles and tend to dissolve in the oil. This results in an extension in the time required for separation and settling of the oil and soap. Moreover, difficulties may be experienced during the subsequent washing operation, inasmuch as the soap may become almost colloidal in character and an amount of washing economically unpractical may be necessary to remove it completely.

If the caustic soda solution of correct strength is added to the oil at the correct temperature, and agitation is conducted properly, the precipitated soap will agglomerate in flocculent form which will be sufficiently large to fall rapidly under gravity and so leave clear oil practically free from soap. Soap must be removed, because complete absence from soap is a necessity to successful bleaching and hardening. For heating, both steam-jacketed vessels and vessels fitted with a steam coil inside are in general use.

Modern American Practice

The practical refiner has always sought means to reduce refining losses and in recent years the urge for a continuous method of refining as a means of improving output has become very strong. Practical experience has indicated that the solution of this problem may be achieved by the introduction of the modern centrifuge into the refinery. Already a number of patents have been granted and many plants installed, and the use of centrifugals for both continuous and semi-continuous methods is the general rule in nearly all American refineries. Undoubtedly the reason for the success which has been attained in the United States is due to the fact that refineries there are considerably larger than elsewhere and, with few exceptions, cottonseed oil alone is worked and the quality of this crude oil varies only within narrow limits.

To those with practical experience in refining it is common knowledge that hardly any two oils of different botanical origin can be refined in the same manner and under the same conditions and it is

this fact which has been primarily responsible for the slow development of a continuous process for all oils of different origin and quality and for refineries of all capacities. There can be no doubt, however, in the minds of those who are best able to judge, that modifications in the construction of centrifugal machines, aligned with continued research into various methods of the actual neutralising stage, whereby the agglomerated soap can be brought into that state best suited for separation from the neutral oil by centrifugal force, will in due course succeed in placing in the hands of oil refiners, large and small, a continuous refining plant capable of dealing with any or all of the various grades of oil and fat on the market. Whatever method of neutralising is chosen, to deal most economically with a given oil, another outstanding consideration is that of reducing the free fatty acid content to at most 0.1 per cent. This is very necessary where subsequent hardening of the oil is to be effected.

Washing and Bleaching

As indicated, the oil after neutralisation must be washed free from soap and alkali. Washing is, preferably carried out in a vessel separate from the neutraliser; generally it now forms part of the bleaching operation, so is done in the bleacher itself. With good graining and separation during neutralisation, subsequent washing of the oil may often be accomplished with water alone. Alternatively the oil may be washed first with a dilute solution of common salt followed by two further washings with water. For this purpose the bleacher is provided with a spray washing equipment.

Bleaching is straightforward, provided the neutral oil has been washed free from soap. The oil before bleaching is vacuum-dried, the bleacher being connected to a vacuum system generally consisting of vacuum pump and condenser. The requisite quantity of bleaching earth is then added and agitated with the oil for the required period of time under reduced pressure and at the temperature previously decided on as being the most suitable for the particular earth and oil. As regards the selection of bleaching earths, some earths or combinations of earths and carbons give better results than others with certain oils. The acid and activated types have good bleaching properties, but are not universally favoured. Possibly the most favoured among oil refiners in general is a combination of a fullers' earth—No. 1 or No. 2 powder—with an activated carbon such as Acticarbone, Carboraffin, Darco, or Norit. A suitable combination of these under specific conditions can be evolved for nearly every grade and type of oil. When bleaching is completed the oil is passed through a filter press which removes the earth and leaves the oil clear, bright and dry. It is then ready for the next stage.

Hydrogen Production

Of all the chemical constants used for the identification of edible oils, the iodine value is the only one which is markedly affected by hydrogenation. The chemist defines "iodine value," as the percentage of iodine absorbed by an oil, fat, or wax. It is in fact a measure of the unsaturated glycerides present in an oil or fat and thus the higher the percentage of these unsaturated glycerides present in an oil the larger will be its iodine value. Hydrogenation causes hydrogen gas to combine with the unsaturated glycerides so that they become saturated; consequently the relative percentage of unsaturated glycerides in the hydrogenated oil is less and the iodine value is reduced.

The reduction in iodine value is directly proportional to the amount of hydrogen which has been added to the oil and therefore the theoretical quantity of hydrogen necessary can be calculated from the difference between the iodine value of the original oil and that of the hardened product required, *i.e.*, the unit reduction in iodine value. Each unit reduction in iodine value, requires approximately 34 cu. ft. of hydrogen per ton of oil. In actual practice, however, more hydrogen than the calculated theoretical amount is required, to allow for venting, leakage, etc. The figure of 40 cu. ft. is a common one for calculating the size of hydrogen plant required.

The provision of hydrogen gas even for the partial hydrogenation of oils for edible purposes invariably represents over 50 per cent. of the total cost of the hardening operation. It will be realised, therefore, that one of the chief problems is that of providing a cheap hydrogen supply. Although in certain chemical processes hydrogen is made in large

quantities as a by-product, these industries are so fundamentally divorced from edible oils and fats that utilisation of the gas for oil-hardening is seldom effected in the same place. In America hydrogen produced in such a manner is sometimes used for hydrogenating certain chemicals closely allied to the particular industry involved. The cost of compressing the gas into cylinders and the difficulty of transportation, apart from the large number of cylinders required even for a hardening plant of moderate size, has not proved economic. Thus today, as for many years now, the two methods of hydrogen production, for the hardened oil industry, have been: (1) the Steam-Iron Process; and (2) the Electrolysis of Water Process.

As recently as two or three years ago hydrogen gas, produced commercially by steam-iron processes, contained other gases which also have a deleterious effect on the oil and/or the catalyst and the progress of the operation. These may be classified as follows:

1. Water vapour, which, as steam, induces splitting of the oil, with the production of free fatty acid.

2. Hydrogen sulphide, which reacts with the catalyst and renders it inactive.

3. Carbon monoxide, which, though it does not affect the hardened product in any way, under normal conditions of oil-hardening undergoes a chemical change with detrimental effect on the catalyst.

4. Carbon dioxide and nitrogen, two inert gases which, although having no effect on either the oil or the catalyst, accumulate, with the continuous circulation of the gas and the absorption of the hydrogen, until their proportion becomes so large as to dilute the hydrogen and thus slow down the operation.

The Steam-Iron Process

To-day the production of hydrogen gas by the steam-iron process (Fig. 2) is typically represented by the Power-Gas Corporation's process and plant. Hydrogen can be produced in a single-stage cyclic process by decomposing steam at elevated temperature, with a reduced iron base contact material. During the reaction, which is a reversible one, the contact material is oxidised and then reduced again. Particular features of the Power-Gas process are the self-contained automatic operation, the low ratio of reducing gas used to hydrogen produced, and the novel methods of purification; and in addition either coke-oven gas or town gas can be used as the reducing medium in place of water gas, with

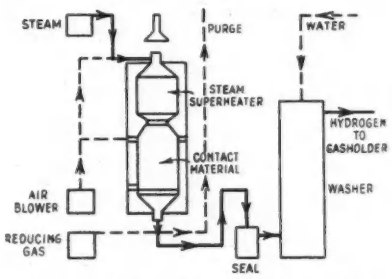

Fig. 2.—Hydrogen production by the steam-iron process.

which it has been the general rule to effect this reduction. During the course of the process, sulphur products and carbon dioxide are completely eliminated, and, by an additional stage of purification, carbon monoxide is reduced to 0.05 per cent. A typical percentage analysis of hydrogen produced by this method is:

Hydrogen	...	...	99.65
Nitrogen	...	...	0.30
Carbon Monoxide		...	0.05

Latterly, by the introduction of a further purification, this residual carbon monoxide can be reduced to not more than 0.005 per cent.

There are a number of well-designed plants available for the production of hydrogen by the electrolysis of water. Hydrogen made by any electrolytic process contains only oxygen and nitrogen as impurities, and a typical analysis of such a gas is as follows:—

Hydrogen	...	...	99.80
Nitrogen	...	...	0.15
Oxygen	...	...	0.05

The cost of electrolytic hydrogen, however, depends largely on the price of available electric current, and only with an exceptionally cheap rate, somewhere in the neighbourhood of ½d. per unit, can it be produced as cheaply as steam-iron hydrogen. From a close study of American technique during the past year or so it is very clear that the steam-iron process for hydrogen production is considered as the obvious method when hydrogenation plants are of reasonably large capacity.

(To be concluded)

Personal Notes

MR. BEN SMITH, National Organiser of the Association of Scientific Workers, has been called up. His successor has not yet been appointed.

SIR FREDERICK GOWLAND HOPKINS, O.M., F.R.S., retires from the Sir William Dunn chair of biochemistry at Cambridge, which he has held since 1921, on September 30. He will be 82 in June. His successor has not yet been appointed.

DR. R. T. ELWORTHY, director of the chemical and explosives production branch of the Canadian Department of Munitions and Supply since 1940, has been appointed head of the new standards section of the War-time Prices and Trade Board set up to investigate possible deterioration in quality of war-time products, particularly those sold to the public.

Obituary

MR. SAMUEL LAWSON, for 56 years with Messrs. William Beardmore and Company, steel manufacturers, Glasgow, died in Glasgow on April 20, aged 70.

MR. HAMILTON WALKER CRAWFORD, chairman of the Briton Ferry Steel and Tinplate Agency, and a director of the Briton Ferry Steel Company and the Neath Steel Sheet and Galvanising Company, has died at Burnham-on-Sea, aged 60.

New Control Orders

Starch and Dextrine

In order to make the most effective use of the starch and dextrine available, it has been found necessary to extend the control over these products. Till now the control covered the sale and purchase of all starches and dextrines, but the use of only certain starches and dextrines. In future control will extend to the use of all of them except for defined domestic purposes. Traders will be required to keep records of usage in addition to records of dealings, except when the goods are used for domestic purposes. The Minister of Food has therefore made a new Order—The Starch and Dextrine (Control) Order, 1943 (S. R. & O. 1943, No. 608), which covers, in addition to the dextrines named in the old Orders, the substance known as "thin boiling starch" and includes arrowroot in the definition of "starch." Under the new Order, which came into force on April 25, there is a statutory obligation on traders to keep records of uses (other than domestic) of starches and dextrines and on holders of licences and authorisations under the Order to comply with the terms of them.

LETTER TO THE EDITOR

Anti-Rust Material

SIR,—In THE CHEMICAL AGE, January 23 and January 30, 1943 (1230-31, pp. 113, 143), are published two short notes concerning anti-rust material, describing the protection of metals with coats to prevent their destruction, specially by sea-water. Great progress has been made in this direction, but metal to an immense value is still destroyed by rust, especially by sea-water corrosion.

The Germans endeavoured to tackle this problem during the last war for other reasons and in a different way. In all possible cases they substituted all metals by non-imported ceramic materials: stoneware, porcelain, steatite, refractories, etc. By careful investigation it was found that these substitutions were not "*ersatz*" but in many cases improvements. Therefore the Germans continued the development of vitreous ceramic materials after the first World War, using them wherever it was advantageous. In connection with sea water one interesting fact might not be generally known: since about 1923 or 1924 the Germans developed sea mines from sea-water-resisting stoneware.

As regards all the mentioned vitreous ceramic materials: stoneware, hard paste porcelain, steatite, etc., we are now as far advanced in England as ever the Germans were.—Yours faithfully,

FELIX SINGER, D.Phil., Dr.Ing., M.I.Chem.E.

South Croydon, Surrey.
April 26, 1943.

THE GLASS INDUSTRY

At the Society of Glass Technology's recent conference on education, technical training, and research for post-war development in the glass industry, the following reforms were suggested: exclusion from the industry of children below the age of 16; scientific selection of entrants at the age of 16, with organised initiation into their job and apprenticeship where appropriate; half-time continued education of workers between the ages of 16 and 18; training in foremanship and a general raising of the education calibre of foremen (in many cases the foremanship function could with advantage be exercised by university graduates); continued facilities for adult education for workers of all ages; the introduction of a much higher proportion of technologists of university degree standard for research, routine control and executive functions; exchange of scientific information and results of research; interchange of research workers between industrial laboratories in the industry and university research departments

Metallurgical Section

Published the first Saturday in the month

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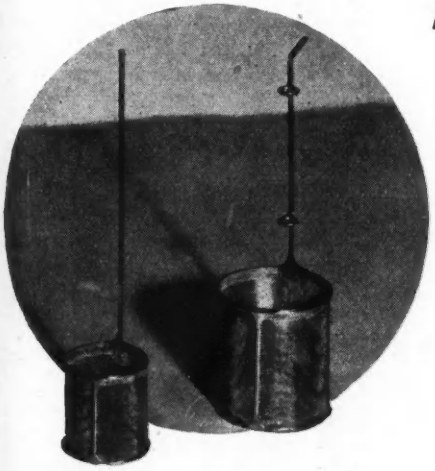

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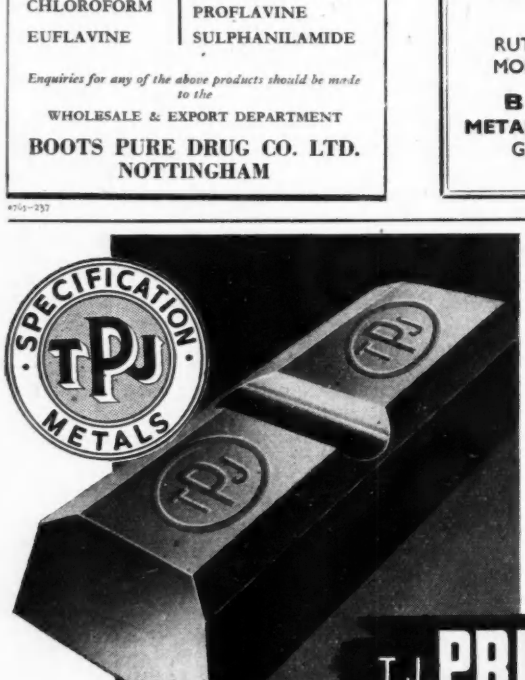

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Metallurgical Section

May 1, 1943

Treatment of Molybdenum Ores

Some Recent Improvements

by A. G. AREND

MOLYBDENUM is a metal which has enjoyed very fluctuating fortunes since it was first isolated more than 150 years ago, and it was long before it received industrial application, at least to any great extent. For many years its principal use was taken to be that of preparing experimental equipment for laboratory practice, special lamp filaments, and other odd researches, but the salts of the metal, which could be economically prepared directly from deposits, were more widely utilised. With the advent of the last war, molybdenum received its first fillip, since steels containing a small percentage of this metal were found to give as good physical results as those containing a much larger proportion of tungsten. The tough strong alloy steel aroused much attention at the time, as in conjunction with cerium it could offer serious competition to the more expensive vanadium steels, used for armour for the magazines of warships, and other vital parts. In the intervening years, until just before the present war, molybdenum experienced lean times, and there was one period when the demand for the metal almost completely disappeared.

Present-Day Uses

In the pure metallic condition, except for the preparation of special non-ferrous molybdenum alloys and for electrical research purposes, the metal receives only limited application to-day. For the preparation of special steels in the form of ferro-molybdenum, calcium molybdate, etc., it is now widely utilised for different armament purposes. Instead of acting as a replacing medium for tungsten, it is nowadays used in conjunction with the latter metal, and, in combination with nickel, chromium, and other constituents, forms a wide variety of important alloy steels for rolls, and other units which claim the greatest demands of high-duty conditions. Consequently, increased interest has been shown in searching for fresh deposits, some of which, fortunately, hail from the U.S.A., Canada, and the French colonies.

Progress in America

Although much of the original research in concentrating, dressing, and electro-metallurgical practice was instituted in Sweden, Germany in the last war period appeared to give most attention to all developments of this metal. This was first seen in the progress made by Chemische Fabrik in Furth G.m.b.H. at Furth, and later by the Ampere company of Berlin, while Krupp of Essen further extended its applications, particularly for the linings of heavy guns, for high-speed steels, etc. Between the two wars, the Molybdenum Corporation of America set up what was easily the largest plant of the kind in the world for the production of the metal, and Germany thus lost what at one time appeared to be a monopoly. It is worth noting that not a few of the special alloys and alloy steels used in the U.S.A. are of German origin, and are protected by American patents, although the actual names may differ.

In earlier years, ferro-molybdenum was the only product which could be obtained directly from molybdenum concentrates. All other products were recovered indirectly, *i.e.*, by a somewhat lengthy wet extraction process using ammoniacal liquors, which processes have been described elsewhere, and need not be repeated. To-day, the latest methods permit of recovering the metal directly in a manner formerly believed impossible, and hence attention has been almost entirely directed towards acquiring the concentrates as expeditiously as possible. The handicaps under which molybdenum laboured are, to-day, also

dissipated. These briefly were that "metallurgists were neither capable of making the addition, nor of executing the subsequent heat-treatment of the alloy steel properly," and that "correct heat-treatments and compositions were restricted by patents and were not thus free for use." (*Chem. and Met. Eng.*, 1918, *19*, 9.)

Milling and Flotation

In comparing mining pursuits in the recovery of molybdenite concentrates, the nature of the improvements made of recent years will be appreciated. After a somewhat elaborate treatment through sets of ball-mills, Duplex-Dorr classifiers, Janney air-mechanical cells, Callow cleaners, and finally vanners, ore containing some 0.9 per cent. of molybdenite was fortunate if it was raised to a concentration of 65 per cent. To-day,

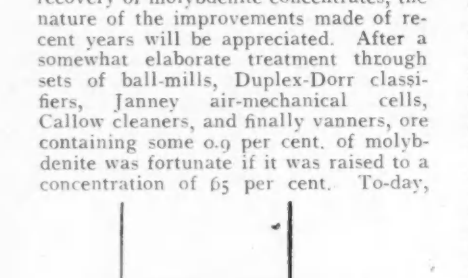


Fig. 1. Section of one modern type of pulverising mill used in treating molybdenum ores.

using an improved plant lay-out, concentration can be raised to 85 per cent. molybdenite. This relates to an enterprise in French Morocco, in the Azegour district, which was set up with the assistance of French, American, and German plant, for the Molybdène Company of Paris. Cheap labour made it practicable to apply manual picking methods which were not economically possible elsewhere. The ore from the mine is first passed through a grizzly which is placed ahead of the crusher, while the fines which are separated are added to that which accumulates from the latter plant. This primary separation is accomplished by means of gratings, grids, or screens, which are so placed that pieces of the desired size only will pass through, while the larger pieces are diverted and subjected to further work.

The screening rings are ingeniously arranged so that any spacing required may be obtained accurately, and the broken ore can again be passed through them by use of belt conveyors. In this connection, a matter of interest is a recent development of belt conveyors which, to-day, can be set up at any odd point to withdraw raw material on the shortest possible notice, instead of having to depend on the usual storage bins. The system is made up of a series of mounting-seats which may be placed on rough terrain, after which the alignment of the belt itself can be trued-up as required. When the material has been withdrawn to a certain extent, an additional section is added to the belt, accompanied by fresh mounting-seats, thus extending the total length so that a loose pile can be easily handled. The fine mass from the crusher and the grizzly is passed through a universal type of vibratory screen, but, in view of the small content of molybdenite in the original ore, picking has then to be performed before the process is proceeded with further. By the method of ejection from the vibratory screen, the oversize material is conveniently spread out on two belts and thus lends itself to simple picking. It is now that advantage is taken of cheap manual labour, whereby the waste material is easily identified and sorted out, leaving the lumps of crude molybdenite to pass directly for comminution.

Where it happens that certain material is more difficult to identify than others (rather a rare occurrence except where some defect has caused excessive waste to be present), use is made of a prepared ultra-violet ray screen. This usually makes the molybdenite appear in a more distinctive colour, and thus assists the hand-picking. The picked lumps are transferred directly to another conveyor belt which leads the mass to crushing rolls; these reduce it to about 0.6 inch size, after which it is again screened. Arrangements are also made for collecting what might be termed intermediate material, *i.e.*, fines of under 0.8 inch size, which are also made to pass to the fine-grinding department.

Much competition has existed between rival firms in connection with the type

of mill best adapted to reducing the mass to suit the prevailing flotation conditions. (*See* Fig. 1). While tube-mills have so far prevailed, efforts have also been made to revive improved forms of existing rotary crushers and modern pulverisers. Recent designs of these are equipped with a screw feed and with the shaft suspended as to its upper part in a spherical bearing, while the lower end is supported eccentrically in a revolving sleeve; but various models exist, all of which aim at obviating idle time, although the latest tube-mills claim similar characteristics. The fine-grinding plant is linked up with a duplex grid-type classifier, so that the fineness of the slurry as received from it amounts to 75 per cent. passing through a 40-mesh sieve. It is claimed that only 3 per cent. is retained by a 32-mesh sieve. The mass is now ready for flotation treatment, and is conveyed by an air-lift pump to a mixer for incorporating the selected reagents.

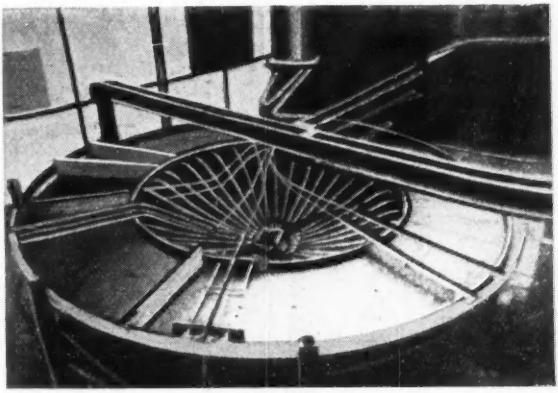


Fig. 2. Disc filter for dewatering the final concentrate.

Molybdenite fortunately lends itself to good concentration by existing flotation methods, although it is known that specially selected reagents were in the course of being tried out both in Colorado and in Morocco. Should vanadite (Sp. gr. 6.6-7,1) make its appearance, the separation at times is rendered more complicated, but this applies particularly when lead molybdate, or wulfenite (sp. gr. 6.7-7.0) has to be dealt with, as the specific gravity of the two minerals are alike. With improved flotation, as distinct from ordinary milling concentration using traditional tables and slimers, these difficulties largely disappear. Selected oils, from which satisfactory results have been secured, have been preferred for molybdenite, the most popular being mixtures of pine oil and kerosene or paraffin oil, until recently when special reagents were substituted which so far do not appear to have been divulged.

Research on Impurity Separation

Batteries of Callow-McIntosh cells, connected in series, receive the flotation slurry and are responsible for making the preliminary separation, whereby the tailings are practically free from molybdenite. In order to separate out the high-grade concentrate, a further small battery of cells of the same make, again connected in series, is used, but the waste material this time has to be returned to the mixer, and passed through for further flotation in the usual manner. It appears that some little difficulty was found with material from the Morocco deposit because of the appearance of small proportions of copper pyrites. Molybdenite possesses a specific gravity of 4.44-4.8, while that of copper pyrites ranges from 4.1 to 4.3, although on occasion it is known to be slightly higher. The margin is thus not very large, and copper is undesirable in the resulting molybdenum, particularly if it has ultimately to be converted to ferro-molybdenum which is the main outlet for consumption. Research was instituted to acquire fresh flotation reagents, and selective flotation was applied, whereby it was claimed that the copper pyrites was prevented from floating. In this connection, it may be of interest to note that methods of a similar character had previously been carried out for causing the latter material to be precipitated out. This relates to the direct use of the selective precipitation of different sulphides according to their respective affinities, by varying the acidity, temperature, conditions, etc. In the light of recent researches using automatic recording pH value controllers, this work should be appreciably simplified and

facilitated, particularly as copper and molybdenum belong to different groups. Although molybdenum is precipitated as sulphide together with copper by the familiar hydrogen sulphide treatment, molybdenum belongs to the arsenic group, and there is thus a variety of methods which can be adapted to suit flotation conditions and prevent the copper from floating. (It will be noted that American analyses of ferro-molybdenum reveal no copper, although in earlier years Sisco pointed out that the U.S.A. navy contemplated the use of molybdenum and copper together).

The final concentrate from the cells is dewatered by the use of a disc filter, of which there have been many different variations in design, all more or less operating on the same principle. The final concentrate, which, as noted, contains 85 per cent. MoS_2, has to be dried before being despatched to the smelter, as some 15 to 18 per cent. of moisture must be removed before it can reach this high figure. Drying is performed by direct heating on a small hearth, as the latest scoop dryers do not justify the expense for this crude class of material.

Most attention nowadays requires to be given to dressing, and other preliminary treatment, up to the point of converting to the ferro-alloy, or oxide, which to-day has been raised to a fine art. Though armament uses claim most attention at present, the future of molybdenum under peace conditions will repay consideration, since just before the present war it was beginning to enjoy increased popularity for bank vault metal, electrical resistance alloys, special wires of increased elongation, high-pressure boiler plates, etc. Molybdenum compounds were also gaining ground in the india-rubber, lubricant, pottery, leather, silk, and chemical industries, and its uses as a catalyst, and in the purification of medicines must not be forgotten.

Impurities in Copper

Effect of Tellurium, Selenium and Bismuth

PAPERS on "The Properties of Commercial Coppers containing Selenium, Tellurium, and Bismuth" by Mr. G. L. Bailey and Mr. A. P. C. Hallowes, and "The Effect of Selenium, Tellurium, and Bismuth on Deoxidised Copper for Tube Manufacture" by Dr. M. Cook and Mr. G. Parker were discussed at the recent annual meeting of the Institute of Metals. The former described investigations on the effects of selenium and tellurium on the manufacturing and working properties of Empire fire-refined coppers, the possibility of using Ookiep copper to dilute Rhokana copper, the behaviour of mixtures of these brands in tube manufacture, the mechanical properties of the tubes, and the properties of strips rolled from the same mixtures. General conclusions drawn were that while effects of selenium and tellurium on copper and permissible limits for these impurities cannot be closely gauged, owing to the greater effects of other elements present, it is clear that in amounts of the order of 0.02-0.03 per cent. and more, these elements reduce the ductility of copper in operations at atmospheric temperature. It should be emphasised that the effects are not so great as to make copper unsuitable for less severe operations, and the presence of these elements does not render copper unsatisfactory for all applications. At the same time small amounts of these elements may determine the suitability of an otherwise pure copper for drastic treatment. The effects of selenium and tellurium on hot-working properties appear to be slight in high-temperature notched-bar tests, but their influence on the hot-piercing behaviour of billets may be considerable.

A summary of the second paper was read by Mr. Cook, who said the work concerned observations made on the processing into tubes by hot-piercing and cold drawing, of 91 heats of arsenical and non-arsenical deoxidised copper containing additions of bismuth, selenium and tellurium, separately and together, in nominal amounts ranging up to 0.006, 0.04, and 0.04 per cent. respectively. Bismuth alone was found to have no adverse effect on the hot and cold-working properties of the coppers, and no harmful effect could be traced to the presence of selenium in the absence of bismuth and tellurium. There was, however, some evidence that tellurium alone may be more harmful than selenium alone. The simultaneous presence of bismuth and selenium was conducive to cold shortness, the degree of which increased with bismuth and selenium additions. Tellurium together with bismuth was found to have a more detrimental effect than the simultaneous presence of selenium and bismuth. Evidence was also obtained which indicated that the embrittling effect arising from the presence of bismuth and tellurium was somewhat decreased by selenium. The effect of these impurities, by and large, was more pronounced in arsenical coppers than in non-arsenical coppers.

Some Modern Rustproof Coatings*

Corronising and Lead Plating

by H. SIMON, B.Sc., A.I.C.

AMONG modern processes of electrodeposited rust-proofing coating, one worthy of mention is corronising, recently developed in the U.S.A. The process consists essentially in plating the steel, after alkali cleaning and anodic etching, with an extremely thin nickel deposit followed by a rather greater thickness of zinc and heat-treating the composite coat. Rimbach (*Metal Finishing*, July, 1941, 360) claims that excellent corrosion resistance is obtained by this method; this claim if substantiated, has the great value, especially under present conditions, of effecting considerable economies in valuable raw materials. Tables I and II give some of Rimbach's results. The heat treatment is variable, depending on the gauge of the metal coated, the conditions it has to withstand and so on, but a typical treatment would consist in heating the coating for six hours at, say, 350° C. The nickel and zinc thicknesses are of the order of 0.000024 in. to 0.000125 in., in the case of the former, and 0.000075 in. to 0.000250 in. in the case of the latter.

TABLE I.—COATINGS ON NO. 22 GAUGE STEEL SHEET.

	Thickness, inches.		*Salt spray hours before failure.*
	Nickel.	*Zinc.*	
Galvanising 0.7 oz./sq.ft.	—	0.0006	60
,, 1.25 ,,	—	0.0011	200
,, 2.5 ,,	—	0.0022	500
Corronising	0.000025	0.000075	60
	0.000060	0.000130	300
	0.000090	0.000120	500

TABLE II.—COATINGS ON NO. 9 WIRE.

	Thickness, inches.	*Salt spray hours before failure.*
Galvanising 0.345 oz. sq. ft.	0.000580	70
,, 0.500 ,, ..	0.000850	120
,, 1.25 ,, ..	0.002000	240
Corronising .. {Ni	0.00010"	
{Zn	0.00010"	140

Lead Plating

Lead plating has not, in the past, received any great attention as a rust-proofing coating on steel because of the ready availability of zinc and cadmium, which are generally considered to be superior in this respect. The war has, however, led to an increased interest in the metal as a protective for steel in general use, as opposed to its special application where resistance to acids (especially sulphuric acid) is concerned. There are two baths commercially used for lead plating, *viz.*, the fluosilicate and the fluoborate baths. The fluosilicate bath cannot be employed on steel without a copper undercoat and it is not really suitable for electro-plating work; it is therefore chiefly used in electro-refining processes.

To all intents and purposes the only present-day bath of interest to the electroplater is the fluoborate bath. Gray and Blum (Electrochem. Soc. Pre-print *80-39*, October 4, 1941) recommend the following solution for the deposition of good lead deposits up to 0.05 in. in thickness and for barrel plating:

Basic lead carbonate, 300 gm./litre
50 per cent. hydrofluoric acid, 480 gm./litre.
Boric acid, 212 gm./litre
Glue, 0.2 gm./litre
Temperature, 77°F.—105°F.
Current density, 10—30 amp./sq. ft.

Anode corrosion is practically 100 per cent., but pure lead anode should be used to prevent sludge formation and "treeing" of the deposit. The perchlorate lead bath also received much attention of late and promising experimental work has been carried out. It has not yet reached the stage of general commercial application, however.

Lead deposits of 0.0005 in. to 0.0010 in. in thickness give reasonable protection against corrosion if of low porosity, but owing to the soft nature of the metal, breaks in the coating occur relatively easily if it is subjected to abrasion; lead is cathodic to iron so that rusting is prone to occur at such breaks more readily than with zinc deposits under conditions of high humidity. With heavier deposits still, the mechanical properties of the coatings are improved and better durability is obtained. For the testing of the porosity of lead deposits Gray and Blum recommend washing the plate in 10 per cent. sulphuric acid to remove particles of iron or iron oxide on the surface and treating with a solution of 20 gm./litre of sulphuric acid and 10 gm./litre of potassium ferricyanide. Bright blue spots appear within about one minute to indicate the presence of pores in the coating.

Good adhesion of lead deposits to steel is obtainable only if special care is taken in the pre-cleaning treatment; for this reason copper is often used as an undercoat to lessen the risk of the deposit lifting, although such an undercoat is by no means essential. Thin copper deposits under the lead do not materially improve the corrosion resistance of the deposit, but heavier undercoats are of value. Lead deposits of 0.003 in., are relatively easily applied in a little over one hour at 20 amp./sq. ft., and when the coating thickness is of this order the finish is very durable.

* Extracts from a paper presented to the Electrodepositors' Technical Society (*J. Electrodepos. Tech. S.*, 1942, *18*, 21-33).

Cypritic Steels*

Acid-Resisting Properties

CYPRITIC steels have many extensive uses in engineering where acid-resisting properties are required, according to Dr. W. H. Hatfield, F.R.S., writing in the *Shipping World* in reply to previous articles on these alloys. Cypritic steel is copper-containing, comprising 74 to 76 per cent. iron, 16 to 18 per cent. chrome and 8 per cent. copper. The major, iron-rich, constituent probably contains 4 to 5 per cent. of copper; the copper-rich constituent contains up to 80 per cent. of copper with chrome, iron, and minor quantities of manganese and silicon. This part is called "cyprite," hence "cypritic."

Dr. Hatfield, who is a director of Thos. Firth and John Brown, Ltd., and Firth Vickers, Ltd., writes: It is some 18 years since investigators in America suggested the range of composition in which the Digby's alloys—cypritic steels—are to be found. These alloys have not achieved industrial importance. It has always been possible, until recently, for such copper-containing steels to achieve success by relative merit, and if they could be effectively produced and had compelling properties, there would be no difficulty now. Steels of this class cannot, of course, be regarded as in any way substitute materials for ordinary mild steel and the low alloy steels, but they have very extensive uses in many branches of engineering where their high anti-rust and acid-resisting properties, coupled with a range of very excellent mechanical properties, have found them wide employment.

In spite of production difficulties, which, certainly for the present, rule out this type of material as an industrial proposition, it is possible with special and meticulous care to obtain worked-down samples, so that consideration can be given to the properties of the ultimate product. For example, a sample bar having the composition per cent.: carbon, 0.03; silicon, 0.45; manganese, 0.36; chromium, 17.81; copper, 8.09; and nickel, 0.08, was tested with the following results:

	Longitudinal	Transverse
Yield point, tons/sq. in.	26.9	27.5
Maximum stress, tons/sq. in. ..	33.5	35.6
Elongation per cent.	32	17.5
Reduction of area per cent. ...	65	39
Bend test	closed flat without cracking.	crack formed when closed flat.

It will be noted that the elongation on the transverse test piece is very much lower than on the longitudinal test piece. It was not possible to carry out an Izod test on the small amount of material available. Corrosion tests on samples from this bar gave results indicating that the material was definitely inferior in acid resistance to 18/8 chromium-nickel steel.

Again, a sample of tube with 3/16 in. wall thickness was examined:—*Composition per cent.*: carbon, 0.04; silicon, 0.47; manganese, 0.30; chromium, 17.01; copper, 8.17; nickel, 0.11.

Mechanical properties: Dimensions of parallel, .247 in. × .13 in. = .0321 sq. in; yield point (tons/sq. in.), 39.1; max. stress (tons/sq. in.), 50.2; elongation per cent. on $4\sqrt{A}$, 18.5; hardness, 214 Brinell; bend test, closed flat satisfactorily.

Corrosion tests were carried out on emeried samples the results being given in the table with comparative figures for a standard 18/8 chromium-nickel steel in the case of the acid tests.

Reagent.	*Concentration.*	*Temperature.*	*Time.*	*Loss in wt. (gm./sq.cm.)*	
				Cypritic tubing.	18/8 *Steel.*
Nitric Acid	S.G. 1.20	20° C.	24 hrs.	0.0024	.0000
Hydrochloric Acid	Conc.	,,	,,	0.1190	.1508
	10%	,,	,,	0.0455	.0048
	2.5%	,,	,,	0.0164	.0032
Sulphuric Acid	50%	,,	,,	0.0685	.0688
	5%	,,	,,	0.0227	.0006
	0.5%	,,	,,	0.0100	.0000
Phosphoric Acid	50%	b.p.	,,	0.0097	.0004
Acetic Acid	B.P.	b.p.	,,	0.1140	.0056
Sea Water	Immersed	Room	48 hrs.	Slight rusting indicating a little inferior to 18/8	

The material showed in these tests a distinctly inferior acid-resistance as compared with 18/8 chromium-nickel steel, but at the same time it possessed quite appreciable resistance to corrosion.

One of the major claims for the chromium-copper steels is that they are free machining. This claim is undoubtedly justified, but in this connection the material should be compared with the free machining chromium or chromium-nickel steels, which are produced without any of the troubles associated with the cypritic material and with higher corrosion resistance than the chromium-copper steels where service conditions make this desirable. Summing up, therefore, it can be agreed that the cypritic type of steel, if successfully and economically manufactured, has quite useful properties. On the other hand, even so, these properties are not outstanding, and can be more than met by existing free-machining rustless irons and steels of the plain chromium or chromium-nickel types.

* Extracts from *The Shipping World*, February 17, 1943, p. 187 and 188.

Electroplating on Aluminium*

The Development of Satisfactory Finishes

ELECTROPLATES on aluminium, such as bright chromium, nickel and oxidised copper, brass and silver, are used primarily for their appearance and the resistance to wear which they afford. These electroplates, while they are perfectly satisfactory where the corrosion conditions are not too severe, may not be satisfactory for continuous outdoor exposure. Chromium applied directly on aluminium has several desirable characteristics. The coatings are ornamental, have high resistance to abrasion and resist alkaline solutions particularly well. Zinc electroplated on aluminium has been used to improve the electrical contact characteristics of the aluminium surface. Zinc or cadmium electroplates have also been used to increase the life of aluminium in certain corrosive environments.

Surface Preparation

The solutions and technique employed for electroplating on aluminium are much the same as for other metals. The important difference lies in the method of surface preparation. Aluminium and its alloys require special surface treatment if the electroplate is to show good adhesion, particularly where there is occasional exposure to moisture. Aluminium, even after this special preliminary treatment, always bears a thin film of oxide on the surface. If the proper treatment has been employed, however, the electroplate will show good adhesion and serviceability on aluminium. The most effective surface treatments produce microscopic pits or cavities which provide anchorage for the electro-deposited metal. The secret of an effective treament lies in making these pits of suitable shape and sufficiently small and uniformly distributed to anchor the coating firmly and permit the applications of a relatively smooth electroplate. The surface treatment employed should be adapted to the particular product and alloy composition to be plated.

The first step in surface preparation is usually an alkaline cleaning treatment, such as immersion in a hot solution of sodium carbonate and tri-sodium phosphate (1 to 3 oz. of each per gallon of water). For the surface preparation of wrought products a widely employed procedure has been to treat the surface with a hydrochloric acid solution containing small amounts of nickel chloride, iron chloride, or manganese sulphate. The time of treatment and the temperature and composition of the solution are determined by experiment for the particular work in hand. In the case of aluminium alloy castings, a useful procedure has been to etch the casting with a nitric acid/hydrofluoric acid solution (3 parts conc. HNO_3 to 1 part of conc. HF). According to a patent of the Aluminum Company of America there is now available a procedure, registered under the trade-mark "Alrok," which is well adapted for the treatment of wrought aluminium products preparatory to plating. A process developed by the Krome-Alume Corporation, of Lockport, N.Y., is also being employed for electroplating aluminium.

Nickel Plating

Nickel is a metal that is commonly plated directly on aluminium. In fact, a preliminary nickel plate may be employed as a foundation for certain other plates, particularly chromium, which when plated over buffed nickel is more attractive than when it is plated directly to the aluminium. The surface should be given a preliminary cleaning and treatment as described above. The choice of a method will depend on the particular product, whether it be a wrought metal or a casting, and on the particular type of finish desired. The plating solutions employed are those in general use for the application of nickel electroplates on other metals; they should have good throwing power and give a soft smooth coating which can be readily buffed to a high lustre. The usual lime buffing compositions may be used. Heat treatment of nickel-plated aluminium parts offers a distinct improvement in the adhesion of the nickel deposit. For the common wrought alloys, heating 6 hours at 150°C. is suggested. For moderate outdoor service a deposit at least 0.001 inch thick is recommended. Generally, the thicker the deposit, the higher the resistance to corrosion.

Chromium Applied Directly

Chromium can be applied directly to aluminium from an ordinary chromium plating bath. For cleaning, a short treatment in the alkaline cleaner already mentioned, followed by immersion in hydrofluoric acid, is all that is required. A slight attack of the aluminium appears necessary to secure an adherent deposit. The chromium invariably emerges from the bath with a dull grey colour. When plated from a hot solution (48°C.), the colour is lighter than when plated from a cold solution (26°C.), but the deposit from the cold solution is more readily polished to a high lustre. This finish is not quite equal in brightness to chromium over nickel, but has numerous applications. Not all chromium-

* From "Finishes for Aluminium," by the Aluminum Company of America, Pittsburgh.

polishing compounds are equally satisfactory for polishing this finish. Test of the materials of the various manufacturers will indicate the most suitable compound. Heavy deposits of hard chromium plate (0.001 to 0.01 inch) are applied to aluminium alloy castings to increase resistance to abrasion.

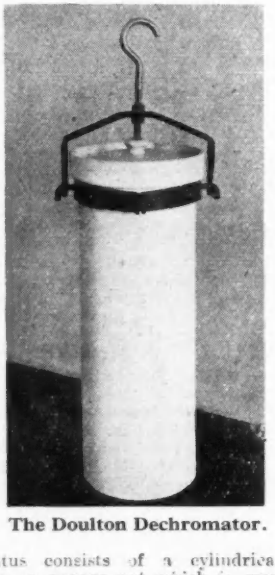
Zinc is plated on aluminium in a thin layer from a cyanide solution. Plating may then be continued in an acid zinc plating solution. Where zinc alone is the metal coating, the plating is quite resistant to corrosion. When other metals, such as nickel or copper, are applied over the preliminary zinc coating, the product does not resist corrosion well, but may blister or peel on exposure to moisture, because of the difference in electrolytic solution potential between these metals and aluminium. Zinc alone, on the other hand, has been used to resist certain types of corrosion.

As has been mentioned, the nickel deposit may serve as a foundation for a variety of other plates. Chromium may be applied over nickel from ordinary chromium baths. The finish is bright, and satisfactory in resistance to corrosion. Copper may also be applied over the nickel from either a cyanide or an acid bath. Generally, the acid bath is better, for it has less tendency to undermine the plating, and particularly good nickel plating is needed. Silver may also be readily applied to the nickel. Coloured or oxidised finishes may be applied on these deposits by the usual procedures. In a few instances, where the colouring solution is strongly alkaline, it is advisable to reduce the strength of the alkali.

The Doulton Dechromator

Economy in Plating Solutions

THE Doulton Dechromator is designed to lengthen the period of service of chromium-plating solutions the necessity for which is emphasised by the present serious shortage of chromic acid. The



The Doulton Dechromator.

apparatus consists of a cylindrical diaphragm or porous pot which is suspended from the cathode bar by a close-fitting hook, which conveys the current by means of a cross-section conductor to four steel cathodes spaced uniformly in the pot. A cover prevents the escape of spray.

In use the porous pot is filled with plating solution to within 4 in. of the top, and is suspended by its hook from the cathode bar. An average voltage across the bath of from 6-8 volts is maintained while the current density permissible for the dechromator is approximately 200 amps. The apparatus is shifted along the bar to different points every thirty minutes and the solution in the tank is stirred.

The theory of operation is as follows: when a chromium bath is first put into service, the content of trivalent chromium (Cr_2O_3) present in the solution is low but it increases during the plating process, until it becomes excessive and causes an increase in the resistance of the bath. This is accompanied by a falling off in the appearance of the deposit until finally it becomes unacceptable. The content of trivalent chrome in the solution should not be allowed to exceed 2 grammes per litre and when this amount is reached the dechromator should be put into operation. The increase of the trivalent chrome is caused by the reduction of the hexavalent chrome in the neighbourhood of the cathode film and to remedy it one employs anodic oxidation. By this process, the trivalent chrome is gradually reformed into hexavalent chrome until more workable proportions are reached. During electrolysis, owing to the reducing action of hydrogen at the cathode, chromium chromate is formed, but this is isolated by separating the anolyte from the catholyte by the cylindrical diaphragm which is semi-permeable and permits the passage of current while maintaining separation of the electrolyte.

The oxidation of trivalent chrome should be carried out as necessary, say once a week, for an approximate period of two hours, for every 110 gallons (500 litres) of solution.

Parliamentary Topics

Non-Skid Roads

IN the House of Commons recently Sir W. Brass asked the Parliamentary Secretary to the Ministry of War Transport whether, in the post-war planning of the London street, he would take powers to prevent local authorities from surfacing their streets with wooden bricks, which form a treacherous surface in wet weather, in view of the fact that the composition of a non-skidding surface is now well known.

Mr. Noel-Baker said that shortly before the war began, a committee was set up by the Ministry of Transport, with the help of the D.S.I.R., to investigate the question of skidding on streets paved with wooden blocks. In its first report, presented in 1940, it recommended forms of surface treatment which had, in practice, proved effective. The Committee had continued their experiments on the subject, and a further recommendation on the subject would shortly be made. In view of these facts, he was not at present satisfied that it would be wise to adopt the course proposed by the questioner.

Penicillin

Major Lyons asked the Minister of Supply whether he would give the names of the members of the committee set up to report upon penicillin and to conduct clinical trials thereon; on what date did the work begin; and when was a report to be expected.

Sir A. Duncan replied that the first meeting of the committee was held on October 13, 1942. The committee, whose object was to secure that all available information regarding clinical and chemical trials and methods of production was collected and exchanged and that everything possible was done to promote the most rapid development, comprised: Mr. Arthur Mortimer, Deputy Director of Medical Supplies, Ministry of Supply (Chairman); Professor A. Fleming, St. Mary's Hospital; Professor H. W. Florey, School of Pathology, University of Oxford; Professor H. Raistrick, London School of Hygiene; Sir Robert Robinson, Dyson Perrins Laboratory, University of Oxford; Dr. C. R. Harrington, Medical Research Council; Dr. A. N. Drury, Medical Research Council; Dr. V. D. Allison, Ministry of Health; Professor I. M. Heilbron, University of Cambridge; Lt.-Col. Sir Russell Wilkinson, Military Medical Advisor, Ministry of Supply; together with representatives of firms engaged in production of penicillin.

Chilean Nitrates

Last week Mr. John Dugdale asked the Minister of Economic Warfare the quantities of copper and nitrate to be shipped from Chile to Spain during this year. Mr. Foot replied that the United Nations had arranged to purchase the whole of Chile's exportable surplus of copper in 1943, and there would be no export of this commodity from Chile to Spain. It was impossible to foretell the precise quantities of nitrates that would be shipped, but Spanish imports of nitrates from all sources would in any case be substantially lower than those in normal peacetime years.

Underground Gasification of Coal

Sir Percy Hurd asked the Minister of Fuel whether he had made the promised inquiries as to the working of the large-scale plants in the Donetz Basin and elsewhere in Russia for the underground gasification of coal and as to the result of experiments in the United States for the extraction by deep boring behind the coal-face of fire-damp for commercial uses. Major Lloyd George replied that reports had been asked for, but had not yet been received. The questioner then asked whether the Minister was aware that the B.B.C. recently stated in the Scottish news service that experiments in the gasification of coal underground were now in progress in a Scottish mine. The Minister said he believed that a small experiment was being carried out. He would let the member have particulars about underground gasification as soon as possible.

Location of Industry

In reply to a question from Mr. Bowles as to the reason for the extension of the Location of Industry Order to cover premises below 3000 sq. ft. in area, Mr. Dalton replied that, under the location of Industry (Restriction) Order, 1941, the starting of any form of production in premises of 3000 sq. ft. or over in area, or a change-over in the type of production carried on in such premises, was subject to the issue of a licence by the Board of Trade. With the progress of the war it became essential to cover all premises, whatever their size, so that there should be no waste anywhere of our resources, whether of space, raw material, or labour. Accordingly, following consultation with the Ministry of Production, an Order was made in October last abolishing the exemption of premises below 3000 sq. ft. in area.

Strychnine as Mole-killer

Mr. R. Morgan asked the Minister of Agriculture whether he was encouraging the use of strychnine to kill moles. Mr. Hudson answered that he was, subject to suitable safeguards.

The fact that goods made of raw materials in short supply owing to war conditions are advertised in this paper should not be taken as an indication that they are necessarily available for export.

General News

From Week to Week

Little vitamin A is lost when eggs are dried, according to biological assays made of Canadian dehydrated eggs.

A £25,000,000 fund to establish a research organisation for the baking industry is projected by the London Master Bakers' and Confectioners' Protection Society.

The A.T.C. Educational Advisory Committee, just appointed by Secretary of State for Air, includes a chemist, Dr. H. Schofield, principal of Loughborough College.

A man who obtained £50 by means of forged documents from the savings bank at I.C.I. Metals, Ltd., has been sentenced to six months' imprisonment.

Messrs. British Unicorn and the Beryllium Smelting Company announce that their offices have been moved to 36/38 Southampton Street, Strand, London, W.C.2. (TEMple Bar 7828 and 7829).

Proceedings have been instituted on behalf of the Minister of Supply against Slugs, Ltd., for sale without licence of non-ferrous scrap. The hearing will take place on May 6, at Bromley Court, Kent.

British exports of animal charcoal to Canada have been discontinued, reports *Canadian Chemistry and Process Industries*. Formerly Canadian companies secured their requirements of this commodity from the United Kingdom.

British railways have lent a special coach to the Ministry of Fuel for a four months' tour, and the Ministry of Information has fitted a fuel-economy exhibition into the coach. The exhibition was opened by Commander Stephen King-Hall, M.P., on Wednesday.

Numerical and classified lists of D.T.D. Specifications published by the Ministry of Aircraft Production, with the list of relevant British Standards, and specifications cancelled since April, 1930 (have been issued by H.M. Stationery Office (price 5d. post free).

Warning about chemical sprays for fruit trees has been issued by the Ministry of Agriculture. Lead arsenate and other arsenical washes are dangerous to honey bees which pollinate fruit trees. They should not be sprayed between the time the buds open and the petals fall.

At the recent annual general meeting of Messrs. Lacrinoid Products, Ltd., the chairman, Mr. T. L. Horabin, M.P., stated that 90 per cent. of the firm's staff are now women, most of whom came without any knowledge of factory work, but who, in a very short time, have justifiably earned the title of craftsmen.

The twenty-fifth Streatfeild Memorial Lecture, "Some Notes on Water Treatment," by Russell G. Pelly, F.I.C., has been published in booklet form by the Institute of Chemistry.

Oil distributors throughout the country have received a letter from the chairman of the Oil Distributors' Emergency Council containing suggestions that may be helpful in carrying out a campaign for the reclamation of waste oil.

Leaflet No. 1 in the series "Methods for the Detection of Toxic Gases in Industry," issued by the D.S.I.R., has been republished at the reduced price of 2s. 6d. It deals with the detection of hydrogen sulphide, and includes a chart of stains.

Abstracts bearing on shellac research literature for the year 1942 have been published by the London Shellac Research Bureau, with author and subject index, and are now obtainable from them at India House, Aldwych, W.C.2.

The second issue of *Fuel Efficiency News*, published by the Ministry of Fuel and Power, has just made its appearance. It includes notes on several recent Fuel Bulletins, especially No. 12, on "Thermal Insulation of Buildings", and No. 16, on "Superheated Steam", and as well as useful suggestions on various subjects to do with fuel. Readers are invited to send in their own suggestions; ideas are worth their weight in—coal.

A summer course of eight weeks on "Modern Methods in Electroplating" is to be held at the Birmingham Central Technical College. The lectures, by Mr. D. W. Wallbank, will take place on Monday and Tuesday evenings from 6.30 to 8.30, beginning on May 3. The fee for the course will be six shillings, together with a deposit for apparatus of five shillings, and application for enrolment should be made to Dr. D. S. Anderson, principal of the college.

The British Colour Council's "Highway Colours," sponsored for the autumn and winter season, do not differ greatly from the spring tones. The colour types are little changed; slightly darker versions of some of the spring colours are introduced as being more practical for autumn days, while two medium browns are introduced as alternatives to the rusts shown in the spring ranges. The ten wool colours form a basis for simple war-time wardrobes, and colours for rayon, cotton, knitwear, hosiery, and leather are correlated with these as basic colours. The number of colours has been pruned to a minimum but a large variety of effects can still be obtained by skilful correlation.

The 1943 edition of Skinner's Mining Year Book has been published. Complete and up-to-date particulars are given concerning 800 companies operating in all parts of the world, together with a list of names and addresses of 888 mining engineers and mine managers. Other features are statistical tables and a buyers' guide to manufacturers of mining equipment. Copies can be obtained from Walter E. Skinner, 20 Copthall Avenue, E.C.2, price 20s. 6d.

Methyl amyl alcohol has been found to have possibilities as a frother both in metallic and non-metallic flotation. It is a pure synthetic chemical compound and therefore more uniform in quality than most natural frothers. In metallic flotation it is generally found that the addition of 10 to 20 per cent. of cresylic acid, pine oil, coal-tar oils, or other hydrocarbons improves the froth. In non-metallic flotation, methyl amyl alcohol is usually most effective when used pure.

A General Licence (S.R. & O. 1943, No. 575) dealing with the use of petroleum products in the manufacture of controlled goods has been issued by the Board of Trade under the Toilet Preparations Order, 1942. Hairdressers who made toilet preparations before October 1, 1941, and are not registered in Part I of the Toilet Preparations Register may now make up for use only small quantities of liquid petroleum products which were purchased before January 1, 1942. This concession refers only to stocks of liquid petroleum products not exceeding five gallons.

Foreign News

The Carborundum Company, Niagara Falls, N.Y., has announced plans for the construction of a new factory.

A graphite deposit has been found near Burnie, Tasmania, which is expected to prove of value in the near future, since Australia is short of this mineral.

A new Swiss company, Gebanit A.G., of Buchler (Appenzell), has been formed to manufacture synthetic rubber and elastic products.

To conserve glycerol in Canada, soap must not contain more than one per cent. glycerine, under a new order of the Canadian Oils and Fats administrator. Manufacturers of "boiled settled soap" are required to recover not less than 92 per cent. of the glycerol content of the soap lyes.

Staple fibre is being produced on a commercial scale by Société Belge de Fibranne in the factory at Zwynaerde, Belgium, which was completed at the end of 1942. The maximum production will be reached only at the end of the current year, owing to supply difficulties, and even then full use will not be made of the plant capacity.

Synthetic rubber by the Svedberg process is now being produced in Sweden by Stockholms Superfosfatfabriks. The company has invested 1,250,000 kr. for the purpose and requires another 275,000 kr. for continued research work.

Stora Kopparbergs Bergslags A/B (Sweden) produced in 1942 49,000 (25,000) tons of cellulose, 15,000 (14,000) tons of basic slag, 74,000 (58,000) tons of pyrites, 30,000 (21,000) tons of sulphuric acid, and increased quantities of alcohol, liquid chlorine, sodium lyes, iron sulphate, copper sulphate, and acetic acid.

Forthcoming Events

The next meeting of the Midlands Centre of the **Electrodepositors' Technical Society** will take place at 6 p.m. on **May 4,** in the James Watt Memorial Institute, Birmingham. Mr. N. A. Tope will speak on "Alkaline Zinc Plating—A Sodium Zincate Solution."

A paper on "The Production and Use of Agricultural Lime" will be presented by Dr. F. P. Stowell to the **Chemical Engineering Group,** the **Agriculture Group** (Society of Chemical Industry), and the **Institution of Chemical Engineers,** at the Institution of Mechanical Engineers, Storey's Gate, S.W.1, at 5 p.m., on **May 4.**

A lecture on "The Maintenance of Soil Fertility," the ninth in a series on Agriculture To-day and To-morrow, will be given before the **Royal Society of Arts,** at 1.45 p.m., on **May 5,** by Mr. E. M. Crowther, D.Sc., F.I.C.

The Pilgrim Trust lecture of the **Royal Society** will take place in Burlington House, at 4.30 p.m., on **May 6.** The speaker, Dr. Karl T. Compton, will take as his subject "The Organisation of American Scientists for the War."

The Liverpool and North-Western section of the **Institute of Chemistry** will hold the annual general meeting and a joint meeting with the local sections of the **Society of Chemical Industry,** the **British Association of Chemists,** and the **Chemical Society,** at 7 p.m., on **May 6,** in the University, Liverpool. A lecture demonstration on "Certain Indicators for Volumetric Analysis" will be given by Dr. A. D. Mitchell.

Dr. W. N. Haworth will speak on "What are Sugars and Starches?" before the **Royal Institution,** at 5 p.m. on **May 7.**

The **Institute of Chemistry,** Tees-Side section, is holding a joint meeting with the Newcastle section of the **Society of Chemical Industry** at Norton Hall, Norton-on-Tees, on **May 8.** Mr. E. J. Bowen, F.R.S., will lecture on "Fluorescence."

The annual council of the **Association of Scientific Workers** will be held on **May 8-9,** at St. Martin's School of Art, 109 Charing Cross Road, London, W.C.2. Sir Robert Watson Watt will take the chair. The agenda includes resolutions covering the internal organisation of the Association, the economic position of scientists, and the place of science and scientists in society in peace and war.

The London section of the **Society of Chemical Industry** will meet jointly with the **Institute of Metals** at the Junior Institution of Engineers, Victoria Street, S.W.1, at 6 p.m. on **May 10,** when Mr. E. A. G. Liddiard will speak on "Modern Methods of Metallurgical Analysis."

Dr. Wilson Baker will speak to the Leeds area section of the **Chemical Society** on "Some Consequences of Hydrogen Bond Formation" at the University, Leeds, at 5.30 p.m., on **May 11.**

Dr. E. M. Delf will speak to the **Royal Society of Arts** on "The Nature and Uses of Seaweeds" at 1.45 p.m. on **May 12.**

The annual general meeting of the South Yorkshire section of the **Institute of Chemistry** will take place on **May 12,** and will include a discussion on the education and training of the chemist, opened by Dr. G. Lawton and Mr. W. F. Andrews. It will be held at 198 West Street, Sheffield.

The annual general meeting of the **Iron and Steel Institute** will take place at 4 Grosvenor Gardens, S.W.1, at 2.45 p.m. on **May 12.** The transaction of official business will be followed by the presentation and discussion of the first report of the Marine Corrosion Sub-Committee, and a review of "Basic Open-Hearth Practice at an Australian Plant."

Dr. H. J. Emeléus will speak on "Modern Technique in Inorganic Chemistry," at a meeting of the **Chemical Society,** at Western Bank, Sheffield, at 5.30 p.m., on **May 14.**

Commercial Intelligence

The following are taken from printed reports, but we cannot be responsible for errors that may occur.

County Court Judgment

SHAW, Ralph, Cleveland Hotel, Llanelly, chemical engineer. (C.C.J. 1/5/43.) £15 4s. 6d. February 23.

Company News

Murex, Ltd., are again paying an interim dividend, in respect of the year to June 30, of 7½ per cent., on the ordinary stock.

Associated Clay Industries, Ltd., have announced a net profit for 1942, of £2026 (£3829).

A dividend of 12½ per cent. (same) has been declared by **Sternol, Ltd.** The trading profit for 1942 was £11,192 (£13,562).

Tunnel Asbestos Cement, Ltd., intend to pay a dividend on the ordinary shares for the thirteen months to December 31, 1942, of 5 per cent. (same).

A trading profit for 1942, of £194,623 (£125,267) has been announced by **General Refractories, Ltd.** The dividend was 7½ per cent. (5 per cent.).

The profit of **British Lead Mills, Ltd.,** for the year to October 31 last, amounted to £21,148 (£8372). The dividend was 10 per cent. (nil).

African Explosives and Industries, Ltd., announce a net profit for the year to September 30, 1942, of £665,253 (£824,725), and a dividend of 7½ per cent., making 25 per cent. (32½ per cent.).

New Companies Registered

Moore's (Sheffield), Ltd. (380,104).—Private company. Capital: £5000 in 5000 shares of £1 each. Manufacturers of and dealers in chemicals, fertilisers, varnishes, colours, etc. Directors: R. V. Moore, Beatrice M. Moore. Registered office: 8-10 Granville Street, Sheffield 2.

Magnesia & Asbestos Insulations, Ltd. (380,102).—Private company. Capital: £1000 in 1000 shares of £1 each. Insulating engineers, manufacturers of and dealers in magnesia plastic and sectional insulations, cork sections and slabs, asbestos mattresses, silicate of cotton, felt wrapping and all forms of insulation, engine and pipe coverings, etc. Directors: J. Harris, Kathleen I. Harris. Registered office: 11 Lincolns Inn Fields, W.C.2.

Chemical and Allied Stocks and Shares

SECURITIES of chemical and allied companies have reflected the firm undertone which continued to rule in Stock Exchange markets. British Aluminium maintained their recent improvement to 50s., while British Oxygen showed a further small rise from 77s. to 77s. 9d., and Lever & Unilever rallied to 35s. 3d. Imperial Chemical had a slightly less active appearance now the preliminary figures for the past year's working have been issued, but were well maintained in price at 38s. 9d. Moreover, Borax Consolidated were steady at 34s. 6d. Dunlop Rubber were also around 34s. 6d. and had a firmer appearance, awaiting the financial results. Dealings up to 47s. were shown in Fisons' ordinary, and around 8s. in Greeff-Chemicals Holdings 5s. units. Monsanto Chemicals 5½ per cent. preference remained at 22s. 6d., and W. J. Bush ordinary at 50s. B. Laporte, which are also firmly held, continued to be quoted at 78s. "middle." On consideration of the im-

proved profits and dividend, General Refractories 10s. ordinary were firmer at 16s. 1½d.; in 1942 profits of the group were at a record level, but the chairman in his statement points out that it should not be assumed that the volume of business will be maintained in the current year. Elsewhere, William Blythe 3s. shares, which remained under the influence of the dividend, changed hands up to 8s. 3d. Leeds Fireclay ordinary further improved and transferred up to 6s. 3d. In other directions, Associated Cement were steady around 60s. on the maintenance of the dividend at 9 per cent.

British Plaster Board were again 28s. 6d., and Wall Paper deferred 37s. Pending the results, United Molasses remained around 28s. 9d. At 86s. the units of the Distillers Co. were unchanged on balance. Cerebos ordinary were around £9⅞, awaiting the dividend announcement. Metal Box were 87s., and Murex at £5⅜ were within a few pence of the level ruling a week ago. Goodlass Wall 10s. ordinary were inclined to show further improvement and transferred up to 13s. 10½d.; the preferred shares marked 14s. 6d. at one time. Among paint shares there was rather more activity in Pinchin Johnson, Paripan, and Blundell Spence. Elsewhere, Allied Ironfounders were more active and higher at 45s. 7½d., pending the forthcoming dividend statement. British Celanese ordinary further improved to 22s. 3d., sentiment being governed by the expected conversion operation in respect of the 5½ per cent. debentures.

British Match at 39s. 3d. showed a further small improvement; the financial results are due shortly. At 17s. 6d. Amalgamated Metal shares were better on balance, while Barry & Staines improved from 41s. 6d. to 41s. 9d., and Nairn & Greenwich remained firm at 66s. 3d. Turner & Newall recorded a rise from 75s. 6d. to 76s. 3d. Boots Drug remained at 41s. 6d., while Sangers were 21s. 7½d., and Timothy Whites 28s. 10½d. At 94s. Tube Investments were slightly higher than a week ago, but Stewarts & Lloyds eased to 54s. Dorman Long remained at 24s. 9d., United Steel at 25s. 9d., and Richard Thomas 6s. 8d ordinary were 9s. 9d. compared with a week ago. Among plastics, British Industrial Plastics 2s. shares were 5s. 10½d., Lacrinoid Products 4s. 6d., and Erinoid 11s. 6d. British Xylonite 5 per cent. preference shares transferred up to 25s. Elsewhere, Imperial Smelting held their recent improvement to 14s. Blythe Colour 4s. ordinary changed hands around 8s. 6d., while there was again a fair amount of activity around 3s. 3d. in British Emulsifiers 2s. shares. Cellon 5s. shares were firm and inclined to show further improvement pending the financial results; dealings at 19s. 9d. and 21s. 3d. were recorded. Enfield Rolling Mills ordinary improved to 17s. 9d. on the annual statement.

British Chemical Prices

Market Reports

A MODERATE volume of new inquiry has been dealt with during the past week on the chemical market, while the movement of supplies is principally against existing contracts which are being satisfactorily drawn against by the majority of consumers. Strong price conditions obtain pretty well throughout the market with a tendency towards higher levels. In the soda products market bicarbonate of soda is being taken up in good quantities and quotations are well held, while a steady inquiry is reported for nitrate of soda, Glauber salt, salt cake and soda ash. Hyposulphite of soda is a good market with quotations firm. There has been no change of importance in the potash section; there is a brisk movement into consumption of permanganate of potash and caustic potash, with supplies of yellow prussiate of potash still scarce. Steady inquiry is reported for acid phosphate of potash. In other directions British makers of red and white leads indicate a steady demand, and buying interest in white acetate of lead keeps up at a satisfactory level. A persistent demand is reported for all grades of borax, and supplies of sulphur, glycerine, and white powdered arsenic are steadily absorbed. Hydrogen peroxide is moving into consumption in good quantities and values are very firm. No important changes fall to be recorded in the coal-tar products market during the past week and strong price conditions are maintained. A fairly active trade is passing in the solvent and heavy naphthas and a steady demand persists for the xylols and toluols. Movements in pitch are reported to be satisfactory.

MANCHESTER.—Brief holiday stoppages at Lancashire textile and allied works affected deliveries of heavy chemicals in the district, and a number of other users also suspended the movement of supplies against contracts, but trade on the Manchester chemical market made a fairly brisk resumption. There has been a certain amount of fresh inquiry for the alkalis, and fair aggregate deliveries of these, as well as of the heavy acids, are being taken up. In carbonate and bicarbonate of ammonia, trade is on steady lines and there is a good demand for most of the acids. With an odd exception the light and heavy tar products are being called for in substantial quantities against contracts.

GLASGOW.—The position in the Scottish heavy chemical trade is unchanged from last week, home business remaining steady. Export trade is still rather restricted. Prices firm.

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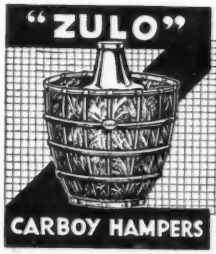

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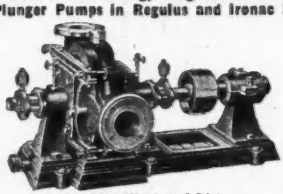

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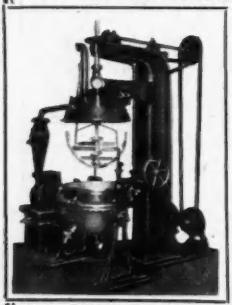

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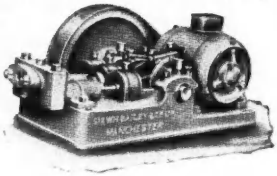

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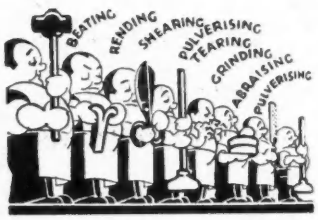

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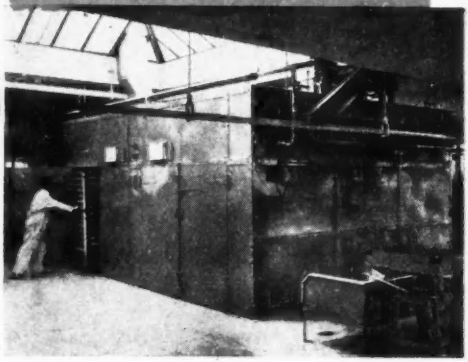

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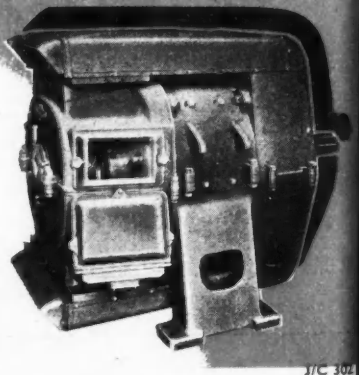

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